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(71) Applicant: FUJITSU LTD

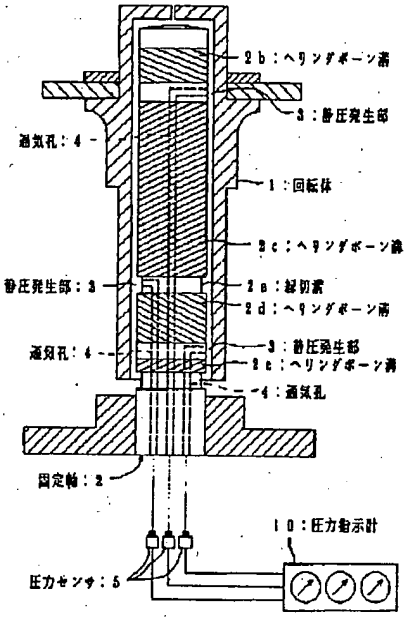
(72) Inventor: MINAMINO YASUYOSHI
MATSUO HIROYUKI

(54) METHOD FOR EVALUATING DYNAMIC PRESSURE GAS BEARING, ITS CLEANING METHOD, AND DYNAMIC PRESSURE GAS BEARING

(57) Abstract:

PURPOSE: To provide a method for evaluating dynamic gas bearing for improving reliability regarding the performance and durability of dynamic pressure gas bearing, a method for cleaning the dynamic gas bearing, and the dynamic pressure gas bearing.

CONSTITUTION: A vent hole 4 for communicating the surrounding of the lower part of a fixed shaft 2 with each static pressure generation part 3 generating static pressure around the fixed shaft 2, is formed in the fixed shaft 2 where a hollow rotator 1 is extermaly engaged with a small space, a pressure sensor 5 is connected to each vent hole 4, and the static pressure of the static pressure generation part 3 when the rotator 1 rotates, is measured by the pressure sensor 5 for evaluation.



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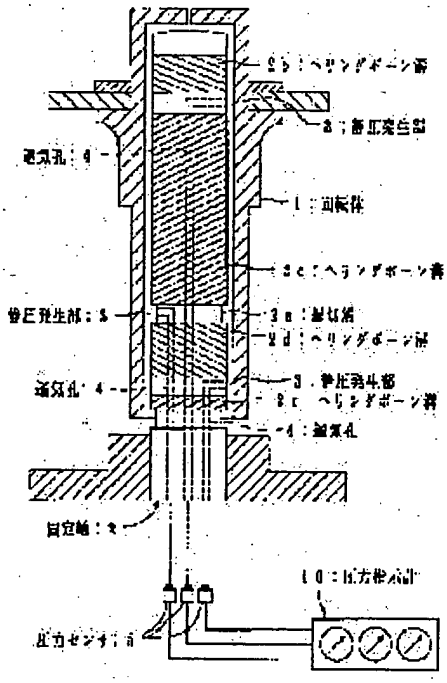

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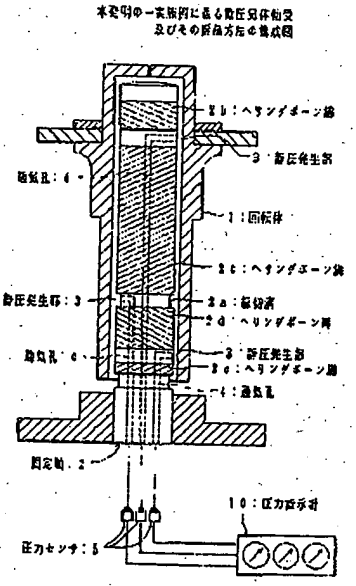
(71)出願人　000005223
富士通株式会社
神奈川県川崎市中原区上小田中1015番地
(72)発明者　岡野　安泰
神奈川県川崎市中原区上小田中1015番地
富士通株式会社内
(72)発明者　松尾　浩幸
神奈川県川崎市中原区上小田中1015番地
富士通株式会社内
(74)代理人　弁理士　井桁　貞一

(54)【発明の名称】　動圧気体軸受の評価方法、清掃方法、及び動圧気体軸受

(57)【要約】
【目的】　動圧気体軸受の評価方法，清掃方法，及び動圧気体軸受に関し，動圧気体軸受の性能や耐久性に対する信頼性を高めることができる動圧気体軸受の評価方法，動圧気体軸受の清掃方法，及び動圧気体軸受を提供することを目的とする。
【構成】　中空の回転体１が微小空間を置いて外嵌される固定軸２内に，該固定軸２の周囲に静圧が発生する各静圧発生部３を該固定軸２の下部の周囲に連通させる通気孔４を形成し，各通気孔４に圧力センサ５を接続して，回転体１の回転時の静圧発生部３の静圧を圧力センサ５で測定して評価する構成とする。



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【特許請求の範囲】

【請求項１】 中空の回転体(1) が微小空間を置いて外嵌される固定軸(2)内に、該固定軸(2) の周囲に静圧が発生する各静圧発生部(3) を該固定軸(2) の下部の周囲に連通する通気孔(4) を形成し、各通気孔(4) に圧力センサ(5) を接続して、回転体(1) の回転時の静圧発生部(3) の静圧を圧力センサ(5) で測定して評価することを特徴とする動圧気体軸受の評価方法。

【請求項２】 中空の回転体(1) が固定軸(2) に微小空間を置いて外嵌される動圧気体軸受の固定軸(2) 内にその周囲に静圧が発生する各静圧発生部(3) を固定軸(2) の下部の周囲に連通する逆し字形の通気孔(4) を形成し、乾燥清浄気体を各通気孔(4) の下端から固定軸(2) の周囲に吹き出させることを特徴とする動圧気体軸受の清掃方法。

【請求項３】 中空の回転体(1) と、該回転体(1) が微小空間を置いて外嵌される固定軸(2) とを備える動圧気体軸受において、

上記固定軸(2) が、該固定軸(2) の周囲に静圧が発生する静圧発生部(3) の周面から該固定軸(2) の内部を通って固定軸(2) の下端面に連通する逆し字形の通気孔(4) と、各通気孔(4) の下端部に着脱され、各通気孔(4) を封止する栓(11)とを備えることを特徴とする動圧気体軸受。

【請求項４】 上記各通気孔(4) の屈曲部に磁石(12)が配置される請求項３に記載の動圧気体軸受。

【請求項５】 磁石(12)が上記栓(11)に支持される請求項４に記載の動圧気体軸受。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、動圧気体軸受の性能を評価する方法、動圧気体軸受の清掃方法及び動圧気体軸受に関する。

【０００２】

【従来の技術】レーザプリンタに使用される高速スキャナモータには、図５の断面図に示すように、回転体１を固定軸２に例えば３０μｍ程度の微小空間を置いて外嵌させた動圧気体軸受が用いられる。

【０００３】この動圧気体軸受の固定軸２の周面の中間高さ部には縁切溝２ａが全周にわたって凹設され、この縁切溝２ａの上下両側の周面にそれぞれ対をなすヘリングボーン溝２ｂ～２ｅが形成される。上下各対をなすヘリングボーン溝２ｂ～２ｅは深さ５～１２μｍ程度で、所定の間隔を置いて互いに逆方向に傾斜させてある。回転体１を回転させると微小空間内の空気が上下の対をなすヘリングボーン溝２ｂ～２ｅの間に寄せられ、固定軸２の上部の周囲の静圧発生部３と下部の周囲の静圧発生部３とに正の静圧が発生し、この圧力によって回転体１が固定軸２に非接触状に支持される。なお、縁切溝２ａの周囲の静圧発生部３には負の静圧が発生している。

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【０００４】

【発明が解決しようとする課題】ところで、この動圧気体軸受は、理論的に求めた設計値にしたがってミクロンオーダーの寸法精度で製造されており、その性能も設計値として求められているに過ぎず、実際の性能、すなわち、軸受圧力の評価は行われていない。

【０００５】また、微小な加工屑による使用初期に発生する焼付き、回転体内周面や固定軸外周面の腐食や回転中の外力による異常接触、焼付き、回転変動等の不具合が発生することがあるが、製品を例えば１２０時間程度のエージランニング（慣らし運転）をしてこれらの不具合が発生するか否かを見極めているにすぎない。

【０００６】したがって、動圧気体軸受の性能や耐久性に対する信頼性は低く、この信頼性を高めるための根本的な解決方法は未だ見出されていない。本発明は、上記の事情を鑑みてなされたものであり、動圧気体軸受の性能や耐久性に対する信頼性を高めることができる動圧気体軸受の評価方法、動圧気体軸受の清掃方法、及び動圧気体軸受を提供することを目的とする。

【０００７】

【課題を解決するための手段】本発明に係る動圧気体軸受の評価方法は、上記の目的を達成するため、例えば図１に示すように、中空の回転体１が微小空間を置いて外嵌される固定軸２内に、該固定軸２の周囲に静圧が発生する各静圧発生部３を該固定軸２の下部の周囲に連通する逆し字形の通気孔４を形成し、各通気孔４に圧力センサ５を接続して、回転体１の回転時の静圧発生部３の静圧を圧力センサ５で測定して評価することを特徴とする。

【０００８】また、本発明に係る動圧気体軸受の清掃方法は、上記の目的を達成するため、例えば図２に示すように、中空の回転体１が固定軸２に微小空間を置いて外嵌される動圧気体軸受の固定軸２内にその周囲に静圧が発生する各静圧発生部３を固定軸２の下部の周囲に連通させる各通気孔４を形成し、乾燥清浄気体を各通気孔４の下端から固定軸１の周囲に吹き出させることを特徴とする。

【０００９】更に、本発明の動圧気体軸受は、上記の動圧気体軸受の評価方法及び動圧気体軸受の清掃方法を実施できるようにするため、例えば図３に示すように、中空の回転体１と、該回転体１が微小空間を置いて外嵌される固定軸２とを備える動圧気体軸受において、上記固定軸２が、該固定軸２の周囲に静圧が発生する各静圧発生部３の周面から該固定軸２の内部を通って固定軸２の下端面に連通する逆し字形の通気孔４と、各通気孔４の下端部に着脱され、各通気孔４を封止する栓１１とを備えることを特徴とする。

【００１０】

【作　用】本発明の動圧気体軸受によれば、栓１１を外すと、通気孔４の下端部に圧力センサ５を接続したり、

乾燥清浄気体を通気孔４に導入したりできる。また、栓１１で通気孔４を封止すれば、通気孔４によって各静圧発生部３の静圧キャパシティが増大され、回転中の外力や低速回転時の求心力が高められる。

【００１１】本発明の動圧気体軸受の評価方法によれば、通気孔４を介して各静圧発生部３の静圧を測定して動圧気体軸受の性能を評価でき、開発段階においては、その評価値に基づいて最適設計値を求めることができ、生産段階においては、製品が要求性能を満たすか否かを検査することができる。

【００１２】また、本発明の動圧気体軸受の清浄方法によれば、各通気孔４を介して回転体１と固定軸２との間の微小空間に乾燥清浄気体を吹き出すことにより、回転体１と固定軸２との表面を乾燥させてこれらの腐食を防止できるとともに、回転体１と固定軸２との間の微小空間から微小な加工屑を排出することができる。

【００１３】

【実施例】以下、本発明の一実施例に係る動圧気体軸受の評価方法、動圧気体の清浄方法及び動圧気体軸受について図面に基づいて具体的に説明する。

【００１４】本発明の前提となる動圧気体軸受は、図１の断面図に示すように、中空の回転体１と、この回転体１が例えば３０μｍ程度の微小空間を置いて外嵌される固定軸２とを備えている。この回転体１は例えばレーザプリンタに使用される高速スキャナモータの回転子であって、１８，５００～２７，５００ｒｐｍ程度の高速で回転する。また、回転体１及び固定軸２は鉄、炭素鋼、ステンレス鋼等の磁性体で造られる。

【００１５】固定軸２の周面の中間高さには縁切溝２ａが全周にわたって凹設され、その上側と下側とにそれぞれ対をなすヘリングボーン溝２ｂ～２ｅが形成される。上下各対をなすヘリングボーン溝２ｂ～２ｅは深さ５～１２μｍ程度で、所定の間隔を置いて互いに逆方向に傾斜させてある。

【００１６】回転体１を回転させると微小空間内の空気が追い回り、上下の対をなすヘリングボーン溝２ｂ～２ｅに案内されて、図４に示すように、上側で対をなすヘリングボーン溝２ｂ，２ｃの間と、下側で対をなすヘリングボーン溝２ｂ，２ｃの間とに空気が寄せられて正の静圧を発生し、この圧力によって回転体１が固定軸２に非接触状に支持される。また、縁切溝２ｂの周囲には負の静圧が発生する。

【００１７】図１に示すように、この動圧気体軸受の固定軸２の内部には、その周囲で静圧が発生する各静圧発生部３を固定軸２の下部の周囲に連通させる３本の通気孔４が形成される。各通気孔４の形状は、特に限定されないが、ここでは、ドリル加工で簡単に通気孔４を形成できるように、静圧発生部３に面する固定軸２の周面から該固定軸２の下面に至る逆Ｌ字形に形成している。

【００１８】なお、通気孔４をコ字形に形成して、通気孔４の下端が固定軸２の周面に開口するように構成することも可能である。図２に示すように、この通気孔４の下端には、フィルタ６、流量制御弁７、クーラ８を介してコンプレッサ９が接続され、コンプレッサ９で加圧され、クーラ８で除湿され、フィルタ６で除塵された乾燥清浄空気が各通気孔４を介して各静圧発生部３に吹き出し、通気孔４及び回転体１と固定軸２との間の微小空間から水分と塵埃とを排出させる。

【００１９】これにより、回転体１と固定軸２との表面が乾燥され、長期間にわたって腐食が発生することを防止できる。また、通気孔４及び回転体１と固定軸２との間の微小空間から塵埃を排出することにより、回転初期に塵埃によって回転摩耗が誘発されることが防止され、回転初期に発生する回転摩耗粉による焼付きを防止できる。また、このような焼付きを防止できるので、エージランニングにおいて回転体１の回転停止頻度を高めて、エージランニング時間を例えば１時間程度に短縮できるとともに、製品の耐久性に対する信頼性を高めることができる。

【００２０】このような手順で動圧気体軸受の清掃をした後、図１に示すように、上記各通気孔４にそれぞれ圧力センサ５を螺着し、これらの圧力センサ５を圧力指示計１０に接続して、各静圧発生部３の圧力を測定（例えば図４のサンプルＮｏ．１～Ｎｏ．６）し、これにより、動圧気体軸受の性能を評価する。

【００２１】開発段階においては、この評価に基づいて最適設計値を求めたり、追加工により最適寸法値や最適寸法精度を求めたりすることができ、生産段階においては、この評価に基づいて要求性能が満たされているか否かの検査ができる。また、この検査を行いながら１時間程度にわたって回転体１を頻繁に回転停止させることにより十分なエージランニングを済ませることができる。

【００２２】このように、要求性能を実際に満たす最適設計値、最適寸法値、最適寸法精度等を求め、実際の製品が要求性能を満たすことを確認してから製品を市場に出すことにより、製品の性能に対する信頼性を著しく高めることができる。

【００２３】これらの性能評価を終了した固定軸２の各通気孔４から圧力センサ５を外した後、図３に示すように、各通気孔４は栓１１で封止される。栓１１で封止された各通気孔４は各静圧発生部３に連通しているので、各通気孔４によって各静圧発生部３の静圧キャパシティが増大され、回転中の外力や低速回転時の求心力が高められる。その結果、回転中の異常接触、焼付き、回転速度変動が発生し難くなり、耐久性を高めることができる。

【００２４】この実施例では、栓１１を各通気孔４の屈曲部の近傍まで延長し、その先端部に通気孔４の周面に接触しないように磁石１２を支持させている。磁石１２は直径０．５～１ｍｍ程度とすればよく、磁石１２と各

通気孔4の周面との隙間は例えば0．5mm程度以上にすればよい。

【0025】この磁石12は、回転中の回転体1と固定軸2との接触により生成される摩耗粉を通気孔4内に吸引して捕捉し．回転体1の内周面及び固定軸2の外周面の摩耗の進行を遅らせる。これにより．焼付き．回転異常及び回転速度変動が長期間にわたって発生し難くなり．耐久性が一層高められる。

【0026】

【発明の効果】以上説明したように．本発明の動圧気体軸受によれば．栓を取り外して乾燥清浄気体を通気孔に送りこむことにより、本発明の動圧気体軸受の清掃方法を実施できる。また、栓を取り外して圧力センサを通気孔に接続することにより本発明の動圧気体軸受の評価方法を実施できる。

【0027】しかも、本発明の動圧気体軸受によれば、栓で通気孔を閉じることにより、通気孔によって静圧キャパシティが増大されて．回転中の外力や低速回転時の求心力が高められ、回転中の異常接触．焼付き．回転速度変動が発生し難くなり．耐久性を高めることができる。

【0028】本発明の動圧気体軸受の清掃方法によれば．通気孔及び回転体の内周面、固定軸の該周面から水分を除去できるので、長期間にわたって回転体の内周面及び固定軸の外周面の腐食を防止でき．耐久性を高めることができる。また、通気孔内及び回転体と固定軸との間の塵埃を除去できるので．回転初期において接触摩耗粉が発生し難くなり、焼付き、異常摩耗などの発生を防止できる。更に．回転初期の焼付き．異常摩耗などの発生を防止できるので、回転体の回転停止頻度を高めてエージランニング時間を短縮できる。

【0029】本発明の動圧気体軸受の評価方法によれば．製品の実際の静圧を圧力センサで測定して．性能を評価できる。したがって．開発段階では、最適設計値、最適寸法値、最適寸法精度等を求めることができ．生産段階では、要求性能が満たされているか否かの検査ができ．出荷された製品に対する耐久性及び性能に対する信頼性を著しく高めることができる。

【図面の簡単な説明】

【図1】本発明の一実施例に係る動圧気体軸受及びその評価方法の構成図である。

【図2】本発明の一実施例に係る動圧気体軸受及びその清掃方法の構成図である。

【図3】本発明の一実施例に係る動圧気体軸受の断面図である。

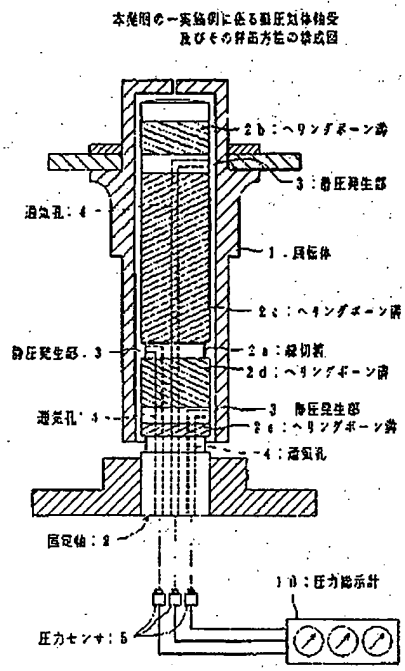
【図4】本発明の固定軸の周囲の圧力分布を示す圧力分布図である。

【図5】従来の動圧気体軸受の断面図である。

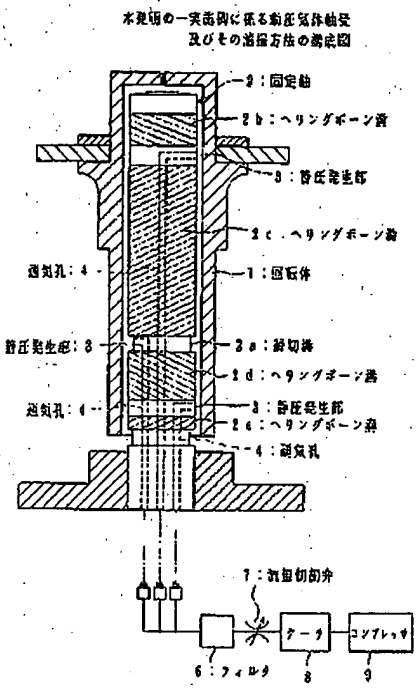
【符合の説明】

1　回転体
2　固定軸
3　静圧発生部
4　通気孔
5　圧力センサ
11　栓
12　磁石

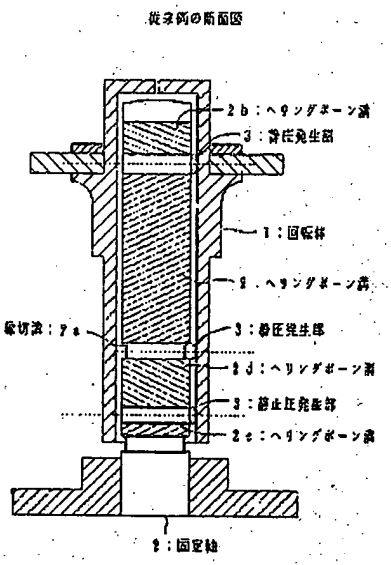
【図1】


本発明の一実施例に係る動圧気体軸受及びその排出方法の構成図
2b：ヘリングボーン溝
3：静圧発生部
通気孔：4
1：回転体
2c：ヘリングボーン溝
静圧発生部：3
2a：絞り溝
2d：ヘリングボーン溝
通気孔：4
3 静圧発生部
2e：ヘリングボーン溝
4：通気孔
固定軸：2
10：圧力指示計
圧力センサ：5

【図2】

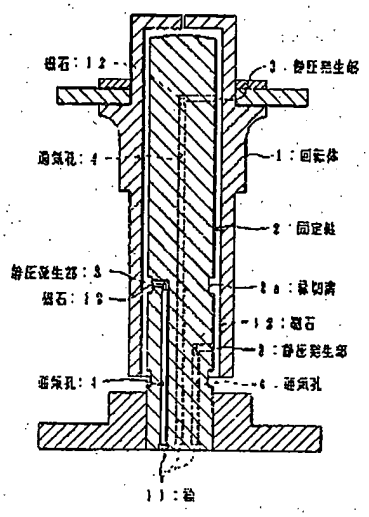

本発明の一実施例に係る動圧気体軸受及びその排出方法の構成図
2：固定軸
2b：ヘリングボーン溝
3：静圧発生部
2c：ヘリングボーン溝
通気孔：4
1：回転体
静圧発生部：3
2a：絞り溝
2d：ヘリングボーン溝
通気孔：4
3：静圧発生部
2e：ヘリングボーン溝
4：通気孔
7：流量制御弁
6：フィルタ
8
9

【図5】


従来例の断面図
2b：ヘリングボーン溝
3：静圧発生部
1：回転体
2：ヘリングボーン溝
絞り溝：7a
3：静圧発生部
2d：ヘリングボーン溝
3：静止圧発生部
2e：ヘリングボーン溝
2：固定軸

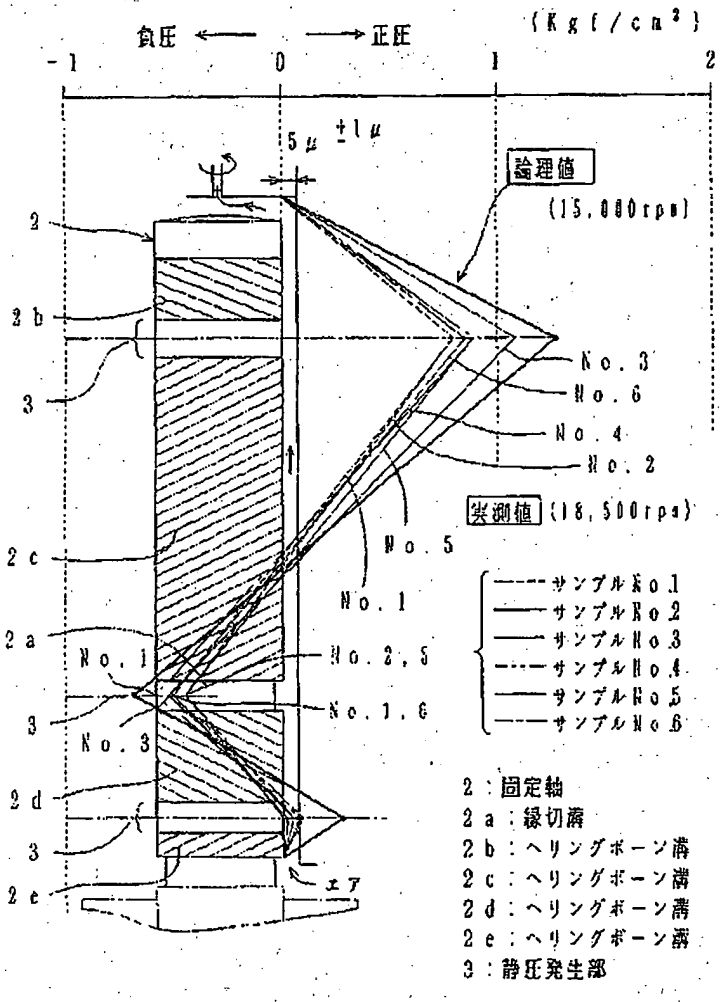
【図3】

本発明の一実施例に係る動圧気体軸受の断面図



【図4】

本発明の固定軸の周囲の圧力分布を示す
圧力分布図



CLAIMS

[Claim(s)]
[Claim 1] Body of revolution in the air (1) In the fixed shaft (2) placed and attached outside, minute space This fixed shaft (2) Each static pressure generating section which a static pressure generates around (3) This fixed shaft (2) Air hole which is open for free passage around lower (4) It forms and is each air hole (4). Pressure sensor (5) It connects. Body of revolution (1) The static pressure generating section at the time of rotation (3) It is a pressure sensor (5) about a static pressure. The evaluation method of the dynamic pressure gas bearing characterized by what is measured and evaluated.
[Claim 2] Body of revolution in the air (1) Fixed shaft (2) Fixed shaft of a dynamic pressure gas bearing which places minute space and is attached outside (2) Each static pressure generating section which a static pressure generates to the circumference inside (3) Fixed shaft (2) Air hole of an inverted-L character form which is open for free passage around lower (4) It forms. It is each air hole (4) about a dryness pure gas. A soffit to fixed shaft (2) The cleaning method of the dynamic pressure gas bearing characterized by making the circumference blow off.
[Claim 3] Body of revolution in the air (1) This body of revolution (1) Fixed shaft which places minute space and is attached outside (2) In the dynamic pressure gas bearing which it has the above-mentioned fixed shaft (2) This fixed shaft (2) The static pressure generating section (3) which a static pressure generates around A peripheral surface to this fixed shaft (2) the interior -- passing -- fixed shaft (2) Air hole (4) of an inverted-L character form which is open for free passage to a soffit side Each air hole (4) It is detached and attached by the soffit section and is each air hole (4). Dynamic pressure gas bearing characterized by having the plug (11) to close.
[Claim 4] Each above-mentioned air hole (4) Dynamic pressure gas bearing according to claim 3 by which a magnet (12) is arranged at a flection.
[Claim 5] The dynamic pressure gas bearing according to claim 4 by which a magnet (12) is supported by the above-mentioned plug (11).

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the method, the cleaning method of a dynamic pressure gas bearing, and dynamic pressure gas bearing which evaluate the performance of a dynamic pressure gas bearing.
[0002]
[Description of the Prior Art] As shown in the cross section of drawing 5 , the dynamic pressure gas bearing outside which put about 30-micrometer minute space on the fixed shaft 2, and it was made to attach body of revolution 1 is used for the high-speed scanner motor used for a LASER beam printer.

[0003] Edge cutting slot 2a is cut in the middle height section of the peripheral surface of the fixed shaft 2 of this dynamic pressure gas bearing over a perimeter, and the herringbone slots 2b-2e which make a pair, respectively to the peripheral surface of the vertical both sides of this edge cutting slot 2a are formed. The herringbone slots 2b-2e which make a vertical each set keep a predetermined interval, and make the opposite direction have inclined mutually in a depth of about 5-12 micrometers. If body of revolution 1 is rotated, it will be brought near among the herringbone slots 2b-2e where the air in minute space makes an up-and-down pair, and a positive static pressure occurs in the static pressure generating section 3 around the upper part of the fixed shaft 2, and the static pressure generating section 3 around lower, and body of revolution 1 is supported by the fixed shaft 2 in the shape of non-contact with this pressure. In addition, the negative static pressure has occurred in the static pressure generating section 3 around edge cutting slot 2a.
[0004]
[Problem(s) to be Solved by the Invention] by the way, this dynamic pressure gas bearing is manufactured by the dimensional accuracy of micron order according to the design value calculated theoretically, and the performance is also called for as a design value -- **** -- it does not pass and evaluation of an actual performance, i.e., bearing pressure, is not performed
[0005] Moreover, although faults, such as unusual contact which occurs in early stages of use by minute processing waste are printed and according to the external force under the corrosion and rotation of body-of-revolution inner skin or a fixed shaft peripheral face, seizure, and rotation change, may occur, it discerns whether age running (running in) of about 120 hours is carried out, and such faults generate a product.
[0006] Therefore, the fundamental solution method for the reliability over the performance and endurance of a dynamic pressure gas bearing being low, and raising this reliability is not yet found out. this invention is made in view of the above-mentioned situation, and aims at offering the evaluation method of the dynamic pressure gas bearing which can raise the reliability over the performance and endurance of a dynamic pressure gas bearing, the cleaning method of a dynamic pressure gas bearing, and a dynamic pressure gas bearing.
[0007]
[Means for Solving the Problem] In order that the evaluation method of the dynamic pressure gas bearing concerning this invention may attain the above-mentioned purpose, As shown in drawing 1 , for example, in the fixed shaft 2 with which the body of revolution 1 in the air places minute space, and is attached outside It is characterized by forming the air hole 4 of an inverted-L character form which opens for free passage each static pressure generating section 3 which a static pressure generates around this fixed shaft 2 around the lower part of this fixed shaft 2, connecting a pressure sensor 5 to each air hole 4, and measuring and evaluating the static pressure of the static pressure generating section 3 at the time of rotation of body of revolution 1 by the pressure sensor 5.
[0008] Moreover, the cleaning method of the dynamic pressure gas bearing concerning this invention In order to attain the above-mentioned purpose, for example, as shown in drawing 2 , each air hole 4 which makes the circumference of the lower part of the fixed shaft 2 open for free passage each static pressure generating section 3 which a static pressure generates to the circumference is formed in the fixed shaft 2 of the dynamic pressure gas bearing outside which the body of revolution 1 in the air puts minute space on the fixed shaft 2, and is attached. It is characterized by making a dryness

pure gas blow off from the soffit of each air hole 4 around the fixed shaft 1.
[0009] Furthermore, in order that the dynamic pressure gas bearing of this invention may enable it to enforce the evaluation method of the above-mentioned dynamic pressure gas bearing, and the cleaning method of a dynamic pressure gas bearing, For example, as shown in drawing 3 , it sets to a dynamic pressure gas bearing equipped with the fixed shaft 2 with which body of revolution 1 and this body of revolution 1 in the air place minute space, and are attached outside. The above-mentioned fixed shaft 2 is detached and attached by the soffit section of the air hole 4 of an inverted-L character form which is open for free passage to the soffit side of the fixed shaft 2 through the interior of this fixed shaft 2, and each air hole 4 from the peripheral surface of each static pressure generating section 3 which a static pressure generates around this fixed shaft 2, and is characterized by having the plug 11 which closes each air hole 4.
[0010]
[For **] According to the dynamic pressure gas bearing of this invention, if a plug 11 is removed, a pressure sensor 5 can be connected to the soffit section of an air hole 4, or a dryness pure gas can be introduced into an air hole 4. Moreover, if an air hole 4 is closed with a plug 11, the static pressure capacity of each static pressure generating section 3 will increase, and the external force under rotation and the centripetal force at the time of low-speed rotation will be heightened by the air hole 4.
[0011] According to the evaluation method of the dynamic pressure gas bearing of this invention, the static pressure of each static pressure generating section 3 can be measured through an air hole 4, the performance of a dynamic pressure gas bearing can be evaluated, an optimal-design value can be calculated in a development stage based on the evaluation value, and it can inspect whether a product fills a military requirement in a production phase.
[0012] Moreover, while according to the cleaning method of the dynamic pressure gas bearing of this invention drying the front face of body of revolution 1 and the fixed shaft 2 and being able to prevent these corrosion by blowing off a dryness pure gas through each air hole 4 to the minute space between body of revolution 1 and the fixed shaft 2, minute processing waste can be discharged from the minute space between body of revolution 1 and the fixed shaft 2.
[0013]
[Example] Hereafter, the evaluation method of the dynamic pressure gas bearing concerning one example of this invention, the cleaning method of a dynamic pressure gas, and a dynamic pressure gas bearing are concretely explained based on a drawing.
[0014] As shown in the cross section of drawing 1 , as for the dynamic pressure gas bearing which will be the requisite for this invention, the body of revolution 1 in the air and this body of revolution 1 are equipped with the fixed shaft 2 which places the minute space which is about 30 micrometers, and is attached outside. This body of revolution 1 is the rotator of the high-speed scanner motor used for a LASER beam printer, and is rotated at the high speed of about 18,500-27,500 rpm. Moreover, body of revolution 1 and the fixed shaft 2 are built with the magnetic substance, such as iron, carbon steel, and stainless steel.
[0015] Edge cutting slot 2a is cut in the middle height of the peripheral surface of the fixed shaft 2 over a perimeter, and the herringbone slots 2b-2e which make a pair to the top and bottom, respectively are formed. The herringbone slots 2b-2e which make a vertical each set keep a predetermined interval, and make the opposite direction have inclined mutually in a depth of about 5-12 micrometers.
[0016] As it will show around in the herringbone slots 2b-2e which the air in minute space takes and make an up-and-down pair the surroundings if body of revolution 1 is rotated, and shown in drawing 4 Air is brought near among the herringbone slots 2b and 2c which make a pair with the down side between the herringbone slots 2b and 2c which make a pair with the up side, a positive static pressure is generated, and body of revolution 1 is supported by the fixed shaft 2 in the shape of non-contact with this pressure. Moreover, a negative static pressure occurs around edge cutting slot 2b.
[0017] As shown in drawing 1 , three air holes 4 which make the circumference of the lower part of the fixed shaft 2 open for free passage each static pressure generating section 3 which a static pressure generates in the circumference are formed in the interior of the fixed shaft 2 of this dynamic pressure gas bearing. Although especially the configuration of each air hole 4 is not limited, as it can

form an air hole 4 easily by drilling, it is formed in the inverted-L character form from the peripheral surface of the fixed shaft 2 facing the static pressure generating section 3 to the inferior surface of tongue of this fixed shaft 2 here.

[0018] In addition, it is also possible to form an air hole 4 in a KO typeface, and to constitute so that the soffit of an air hole 4 may carry out opening to the peripheral surface of the fixed shaft 2. The dryness pure air by which the compressor 9 was connected through the filter 6, the flow control valve 7, and the cooler 8, was pressurized by the compressor 9, and was dehumidified by the cooler 8, and dust removing was carried out with the filter 6 blows off in each static pressure generating section 3 through each air hole 4, and makes the soffit of this air hole 4 discharge moisture and dust from the minute space between an air hole 4 and body of revolution 1, and the fixed shaft 2, as shown in drawing 2 .

[0019] Thereby, the front face of body of revolution 1 and the fixed shaft 2 is dried, and it can prevent that corrosion occurs over a long period of time. Moreover, by discharging dust from the minute space between an air hole 4 and body of revolution 1, and the fixed shaft 2, in early stages of rotation, it is prevented that rotation wear is induced by dust and it can prevent the seizure by the rotation wear powder generated in early stages of rotation. Moreover, since such seizure can be prevented, while raising the rotation halt frequency of body of revolution 1 in age running and being able to shorten age running time in about 1 hour, the reliability over the endurance of a product can be raised.

[0020] After such a procedure cleans a dynamic pressure gas bearing, as shown in drawing 1 , a pressure sensor 5 is screwed on each above-mentioned air hole 4, respectively, these pressure sensors 5 are connected to a pressure indicator 10, the pressure of each static pressure generating section 3 is measured (for example, sample No.1-No.6 of drawing 4), and this evaluates the performance of a dynamic pressure gas bearing.

[0021] In a development stage, based on this evaluation, an optimal-design value can be calculated, or an optimum-size value and optimum-size precision can be searched for by ******, and inspection of whether the military requirement is filled based on this evaluation can be performed in a production phase. Moreover, sufficient age running can be finished by carrying out a rotation halt of the body of revolution 1 frequently over about 1 hour, conducting this inspection.

[0022] Thus, the reliability over the performance of a product can be remarkably raised by searching for the optimal-design value with which a military requirement is actually filled, an optimum-size value, optimum-size precision, etc., and taking out a product to a commercial scene, after checking that an actual product fills a military requirement.

[0023] After removing a pressure sensor 5 from each air hole 4 of the fixed shaft 2 which ended these performance evaluations, as shown in drawing 3 , each air hole 4 is closed with a plug 11. Since each air hole 4 closed with the plug 11 is open for free passage in each static pressure generating section 3, the static pressure capacity of each static pressure generating section 3 increases, and the external force under rotation and the centripetal force at the time of low-speed rotation are heightened by each air hole 4. Consequently, it is hard coming to generate the unusual contact under rotation, seizure, and rotational-speed change, and endurance can be raised.

[0024] A plug 11 is extended to near the flection of each air hole 4, and the magnet 12 is made to support in this example, so that the point may not be contacted at the peripheral surface of an air hole 4. A magnet 12 should just set the crevice between a magnet 12 and the peripheral surface of each air hole 4 to about 0.5mm or more that what is necessary is just to consider as the diameter of about 0.5-1mm.

[0025] This magnet 12 attracts and captures the wear powder generated by contact on the body of revolution 1 under rotation, and the fixed shaft 2 in an air hole 4, and delays advance of wear of the inner skin of body of revolution 1, and the peripheral face of the fixed shaft 2. Thereby, it is hard coming to generate seizure, the abnormalities in rotation, and rotational-speed change over a long period of time, and endurance is raised further.

[0026]

[Effect of the Invention] As explained above, according to the dynamic pressure gas bearing of this invention, the cleaning method of the dynamic pressure gas bearing of this invention can be enforced by removing a plug and sending a dryness pure gas into an air hole. Moreover, the evaluation

method of the dynamic pressure gas bearing of this invention can be enforced by removing a plug and connecting a pressure sensor to an air hole.

[0027] And according to the dynamic pressure gas bearing of this invention, by closing an air hole with a plug, a static pressure capacity increases, the external force under rotation and the centripetal force at the time of low-speed rotation are heightened, it is hard coming to generate the unusual contact under rotation, seizure, and rotational-speed change, and endurance can be raised by the air hole.

[0028] According to the cleaning method of the dynamic pressure gas bearing of this invention, since moisture is removable from the inner skin of an air hole and body of revolution, and this peripheral surface of a fixed shaft, the corrosion of the inner skin of body of revolution and the peripheral face of a fixed shaft can be prevented over a long period of time, and endurance can be raised. Moreover, since the dust between body of revolution and the fixed shaft in an air hole is removable, in the early stages of rotation, it is hard coming to generate contact wear powder, it is printed, and can prevent generating of anomalous attrition etc. Furthermore, since generating of the seizure in early stages of rotation, anomalous attrition, etc. can be prevented, the rotation halt frequency of body of revolution is raised, and age running time can be shortened.

[0029] According to the evaluation method of the dynamic pressure gas bearing of this invention, the actual static pressure of a product is measured by the pressure sensor, and a performance can be evaluated. Therefore, in a development stage, an optimal-design value, an optimum-size value, optimum-size precision, etc. can be searched for, and inspection of whether the military requirement is filled with the production phase can be performed, and can raise remarkably the endurance over the shipped product, and the reliability over a performance.

TECHNICAL FIELD

[Industrial Application] this invention relates to the method, the cleaning method of a dynamic pressure gas bearing, and dynamic pressure gas bearing which evaluate the performance of a dynamic pressure gas bearing.

PRIOR ART

[Description of the Prior Art] As shown in the cross section of drawing 5 , the dynamic pressure gas bearing outside which put about 30-micrometer minute space on the fixed shaft 2, and it was made to attach body of revolution 1 is used for the high-speed scanner motor used for a LASER beam printer.

[0003] Edge cutting slot 2a is cut in the middle height section of the peripheral surface of the fixed shaft 2 of this dynamic pressure gas bearing over a perimeter, and the herringbone slots 2b-2e which make a pair, respectively to the peripheral surface of the vertical both sides of this edge cutting slot 2a are formed. The herringbone slots 2b-2e which make a vertical each set keep a predetermined interval, and make the opposite direction have inclined mutually in a depth of about 5-12 micrometers. If body of revolution 1 is rotated, it will be brought near among the herringbone slots 2b-2e where the air in minute space makes an up-and-down pair, and a positive static pressure occurs in the static pressure generating section 3 around the upper part of the fixed shaft 2, and the static pressure generating section 3 around lower, and body of revolution 1 is supported by the fixed shaft 2 in the shape of non-contact with this pressure. In addition, the negative static pressure has occurred in the static pressure generating section 3 around edge cutting slot 2a.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to the dynamic pressure gas bearing of this invention, the cleaning method of the dynamic pressure gas bearing of this invention can be enforced by removing a plug and sending a dryness pure gas into an air hole. Moreover, the evaluation method of the dynamic pressure gas bearing of this invention can be enforced by removing a plug and connecting a pressure sensor to an air hole.

[0027] And according to the dynamic pressure gas bearing of this invention, by closing an air hole with a plug, a static pressure capacity increases, the external force under rotation and the centripetal force at the time of low-speed rotation are heightened, it is hard coming to generate the unusual contact under rotation, seizure, and rotational-speed change, and endurance can be raised by the air hole.

[0028] According to the cleaning method of the dynamic pressure gas bearing of this invention, since moisture is removable from the inner skin of an air hole and body of revolution, and this peripheral surface of a fixed shaft, the corrosion of the inner skin of body of revolution and the peripheral face of a fixed shaft can be prevented over a long period of time, and endurance can be raised. Moreover, since the dust between body of revolution and the fixed shaft in an air hole is removable, in the early stages of rotation, it is hard coming to generate contact wear powder, it is printed, and can prevent generating of anomalous attrition etc. Furthermore, since generating of the seizure in early stages of rotation, anomalous attrition, etc. can be prevented, the rotation halt frequency of body of revolution is raised, and age running time can be shortened.

[0029] According to the evaluation method of the dynamic pressure gas bearing of this invention, the actual static pressure of a product is measured by the pressure sensor, and a performance can be evaluated. Therefore, in a development stage, an optimal-design value, an optimum-size value, optimum-size precision, etc. can be searched for, and inspection of whether the military requirement is filled with the production phase can be performed, and can raise remarkably the endurance over the shipped product, and the reliability over a performance.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] by the way, this dynamic pressure gas bearing is manufactured by the dimensional accuracy of micron order according to the design value calculated theoretically, and the performance is also called for as a design value -- **** -- it does not pass and evaluation of an actual performance, i.e., bearing pressure, is not performed

[0005] Moreover, although faults, such as unusual contact which occurs in early stages of use by minute processing waste are printed and according to the external force under the corrosion and rotation of body-of-revolution inner skin or a fixed shaft peripheral face, seizure, and rotation change, may occur, it discerns whether age running (running in) of about 120 hours is carried out, and such faults generate a product.

[0006] Therefore, the fundamental solution method for the reliability over the performance and endurance of a dynamic pressure gas bearing being low, and raising this reliability is not yet found out. this invention is made in view of the above-mentioned situation, and aims at offering the evaluation method of the dynamic pressure gas bearing which can raise the reliability over the performance and endurance of a dynamic pressure gas bearing, the cleaning method of a dynamic pressure gas bearing, and a dynamic pressure gas bearing.

MEANS

[Means for Solving the Problem] In order that the evaluation method of the dynamic pressure gas bearing concerning this invention may attain the above-mentioned purpose, As shown in drawing 1 , for example, in the fixed shaft 2 with which the body of revolution 1 in the air places minute space, and is attached outside It is characterized by forming the air hole 4 of an inverted-L character form which opens for free passage each static pressure generating section 3 which a static pressure generates around this fixed shaft 2 around the lower part of this fixed shaft 2, connecting a pressure sensor 5 to each air hole 4, and measuring and evaluating the static pressure of the static pressure generating section 3 at the time of rotation of body of revolution 1 by the pressure sensor 5.
[0008] Moreover, the cleaning method of the dynamic pressure gas bearing concerning this invention In order to attain the above-mentioned purpose, for example, as shown in drawing 2 , each air hole 4 which makes the circumference of the lower part of the fixed shaft 2 open for free passage each static pressure generating section 3 which a static pressure generates to the circumference is formed in the fixed shaft 2 of the dynamic pressure gas bearing outside which the body of revolution 1 in the air puts minute space on the fixed shaft 2, and is attached. It is characterized by making a dryness pure gas blow off from the soffit of each air hole 4 around the fixed shaft 1.
[0009] Furthermore, in order that the dynamic pressure gas bearing of this invention may enable it to enforce the evaluation method of the above-mentioned dynamic pressure gas bearing, and the cleaning method of a dynamic pressure gas bearing, For example, as shown in drawing 3 , it sets to a dynamic pressure gas bearing equipped with the fixed shaft 2 with which body of revolution 1 and this body of revolution 1 in the air place minute space, and are attached outside. The above-mentioned fixed shaft 2 is detached and attached by the soffit section of the air hole 4 of an inverted-L character form which is open for free passage to the soffit side of the fixed shaft 2 through the interior of this fixed shaft 2, and each air hole 4 from the peripheral surface of each static pressure generating section 3 which a static pressure generates around this fixed shaft 2, and is characterized by having the plug 11 which closes each air hole 4.
[0010]
[For **] According to the dynamic pressure gas bearing of this invention, if a plug 11 is removed, a pressure sensor 5 can be connected to the soffit section of an air hole 4, or a dryness pure gas can be introduced into an air hole 4. Moreover, if an air hole 4 is closed with a plug 11, the static pressure capacity of each static pressure generating section 3 will increase, and the external force under rotation and the centripetal force at the time of low-speed rotation will be heightened by the air hole 4.
[0011] According to the evaluation method of the dynamic pressure gas bearing of this invention, the static pressure of each static pressure generating section 3 can be measured through an air hole 4, the performance of a dynamic pressure gas bearing can be evaluated, an optimal-design value can be calculated in a development stage based on the evaluation value, and it can inspect whether a product fills a military requirement in a production phase.
[0012] Moreover, while according to the cleaning method of the dynamic pressure gas bearing of this invention drying the front face of body of revolution 1 and the fixed shaft 2 and being able to prevent these corrosion by blowing off a dryness pure gas through each air hole 4 to the minute space between body of revolution 1 and the fixed shaft 2, minute processing waste can be discharged from the minute space between body of revolution 1 and the fixed shaft 2.

EXAMPLE

[Example] Hereafter, the evaluation method of the dynamic pressure gas bearing concerning one example of this invention, the cleaning method of a dynamic pressure gas, and a dynamic pressure gas bearing are concretely explained based on a drawing.
[0014] As shown in the cross section of drawing 1 , as for the dynamic pressure gas bearing which will be the requisite for this invention, the body of revolution 1 in the air and this body of revolution 1 are equipped with the fixed shaft 2 which places the minute space which is about 30 micrometers, and is attached outside. This body of revolution 1 is the rotator of the high-speed scanner motor used for a LASER beam printer, and is rotated at the high speed of about 18,500-27,500 rpm. Moreover, body of revolution 1 and the fixed shaft 2 are built with the magnetic substance, such as iron, carbon steel, and stainless steel.
[0015] Edge cutting slot 2a is cut in the middle height of the peripheral surface of the fixed shaft 2 over a perimeter, and the herringbone slots 2b-2e which make a pair to the top and bottom, respectively are formed. The herringbone slots 2b-2e which make a vertical each set keep a predetermined interval, and make the opposite direction have inclined mutually in a depth of about 5-12 micrometers.
[0016] As it will show around in the herringbone slots 2b-2e which the air in minute space takes and make an up-and-down pair the surroundings if body of revolution 1 is rotated, and shown in drawing 4 Air is brought near among the herringbone slots 2b and 2c which make a pair with the down side between the herringbone slots 2b and 2c which make a pair with the up side, a positive static pressure is generated, and body of revolution 1 is supported by the fixed shaft 2 in the shape of non-contact with this pressure. Moreover, a negative static pressure occurs around edge cutting slot 2b.
[0017] As shown in drawing 1 , three air holes 4 which make the circumference of the lower part of the fixed shaft 2 open for free passage each static pressure generating section 3 which a static pressure generates in the circumference are formed in the interior of the fixed shaft 2 of this dynamic pressure gas bearing. Although especially the configuration of each air hole 4 is not limited, as it can form an air hole 4 easily by drilling, it is formed in the inverted-L character form from the peripheral surface of the fixed shaft 2 facing the static pressure generating section 3 to the inferior surface of tongue of this fixed shaft 2 here.
[0018] In addition, it is also possible to form an air hole 4 in a KO typeface, and to constitute so that the soffit of an air hole 4 may carry out opening to the peripheral surface of the fixed shaft 2. The dryness pure air by which the compressor 9 was connected through the filter 6, the flow control valve 7, and the cooler 8, was pressurized by the compressor 9, and was dehumidified by the cooler 8, and dust removing was carried out with the filter 6 blows off in each static pressure generating section 3 through each air hole 4, and makes the soffit of this air hole 4 discharge moisture and dust from the minute space between an air hole 4 and body of revolution 1, and the fixed shaft 2, as shown in drawing 2 .
[0019] Thereby, the front face of body of revolution 1 and the fixed shaft 2 is dried, and it can prevent that corrosion occurs over a long period of time. Moreover, by discharging dust from the minute space between an air hole 4 and body of revolution 1, and the fixed shaft 2, in early stages of rotation, it is prevented that rotation wear is induced by dust and it can prevent the seizure by the rotation wear powder generated in early stages of rotation. Moreover, since such seizure can be prevented, while raising the rotation halt frequency of body of revolution 1 in age running and being able to shorten age running time in about 1 hour, the reliability over the endurance of a product can be raised.
[0020] After such a procedure cleans a dynamic pressure gas bearing, as shown in drawing 1 , a pressure sensor 5 is screwed on each above-mentioned air hole 4, respectively, these pressure sensors 5 are connected to a pressure indicator 10, the pressure of each static pressure generating section 3 is measured (for example, sample No.1-No.6 of drawing 4), and this evaluates the performance of a dynamic pressure gas bearing.
[0021] In a development stage, based on this evaluation, an optimal-design value can be calculated, or an optimum-size value and optimum-size precision can be searched for by ******, and inspection of whether the military requirement is filled based on this evaluation can be performed in a

production phase. Moreover, sufficient age running can be finished by carrying out a rotation halt of the body of revolution 1 frequently over about 1 hour, conducting this inspection.

[0022] Thus, the reliability over the performance of a product can be remarkably raised by searching for the optimal-design value with which a military requirement is actually filled, an optimum-size value, optimum-size precision, etc., and taking out a product to a commercial scene, after checking that an actual product fills a military requirement.

[0023] After removing a pressure sensor 5 from each air hole 4 of the fixed shaft 2 which ended these performance evaluations, as shown in drawing 3 , each air hole 4 is closed with a plug 11. Since each air hole 4 closed with the plug 11 is open for free passage in each static pressure generating section 3, the static pressure capacity of each static pressure generating section 3 increases, and the external force under rotation and the centripetal force at the time of low-speed rotation are heightened by each air hole 4. Consequently, it is hard coming to generate the unusual contact under rotation, seizure, and rotational-speed change, and endurance can be raised.

[0024] A plug 11 is extended to near the flection of each air hole 4, and the magnet 12 is made to support in this example, so that the point may not be contacted at the peripheral surface of an air hole 4. A magnet 12 should just set the crevice between a magnet 12 and the peripheral surface of each air hole 4 to about 0.5mm or more that what is necessary is just to consider as the diameter of about 0.5-1mm.

[0025] This magnet 12 attracts and captures the wear powder generated by contact on the body of revolution 1 under rotation, and the fixed shaft 2 in an air hole 4, and delays advance of wear of the inner skin of body of revolution 1, and the peripheral face of the fixed shaft 2. Thereby, it is hard coming to generate seizure, the malrotation, and rotational-speed change over a long period of time, and endurance is raised further.

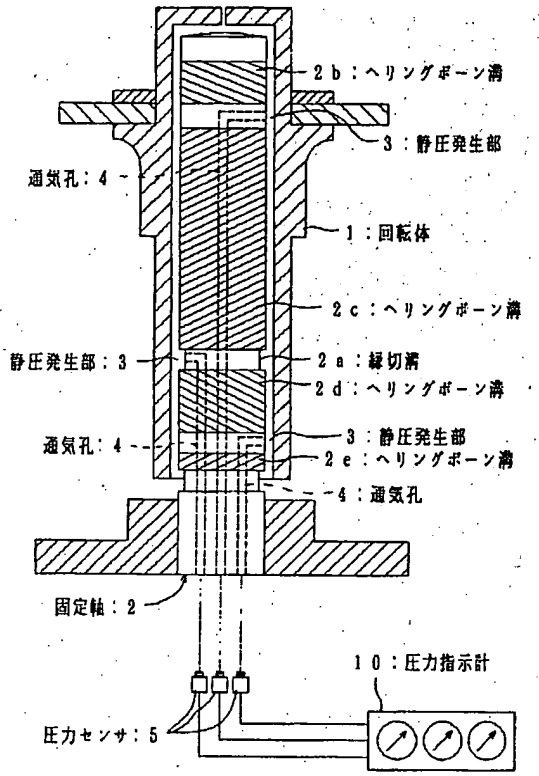
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the dynamic pressure gas bearing concerning one example of this invention, and its evaluation method.
[Drawing 2] It is the block diagram of the dynamic pressure gas bearing concerning one example of this invention, and its cleaning method.
[Drawing 3] It is the cross section of the dynamic pressure gas bearing concerning one example of this invention.
[Drawing 4] It is the pressure distribution chart showing the pressure distribution around the fixed shaft of this invention.
[Drawing 5] It is the cross section of the conventional dynamic pressure gas bearing.
[Explanation of agreement]
1 Body of Revolution
2 Fixed Shaft
3 Static Pressure Generating Section
4 Air Hole
5 Pressure Sensor
11 Plug
12 Magnet

DRAWINGS

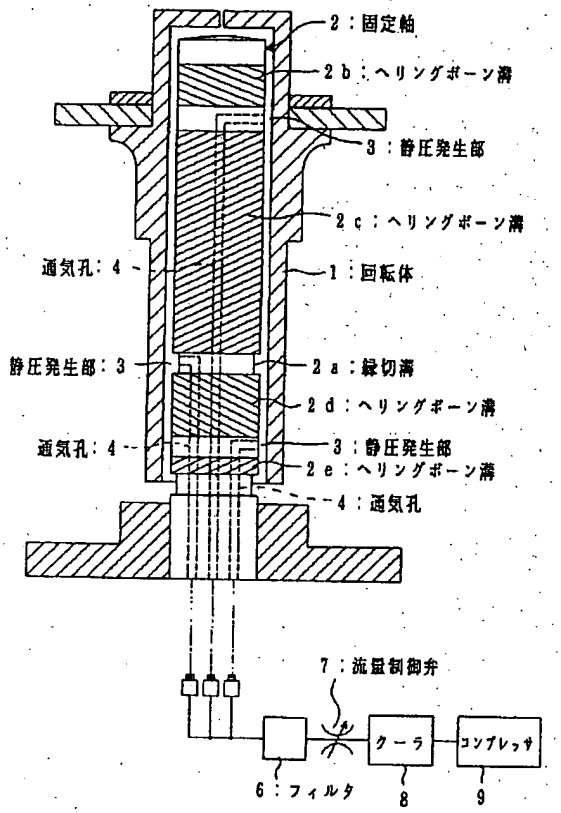
[Drawing 1]

本発明の一実施例に係る動圧気体軸受
及びその評価方法の構成図



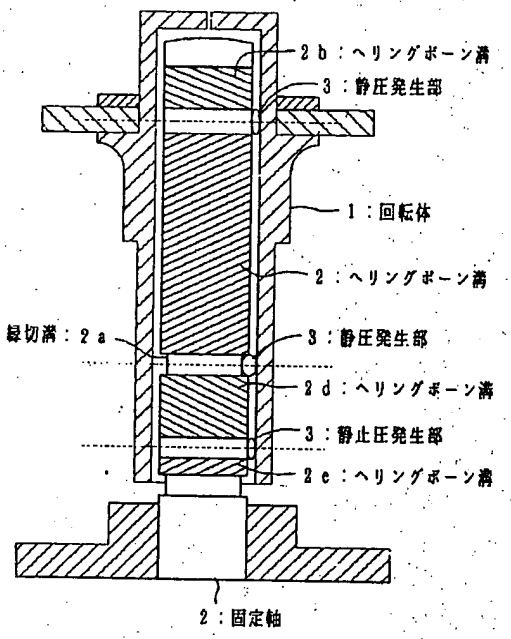
[Drawing 2]

本発明の一実施例に係る動圧気体軸受
及びその潤滑方法の構成図



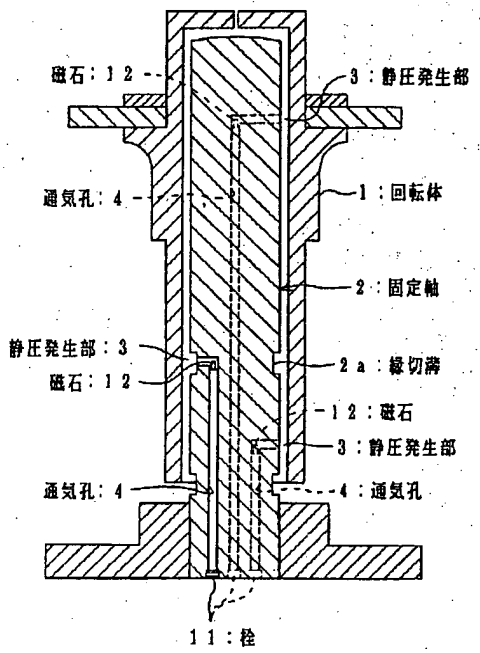
[Drawing 5]

従来例の断面図



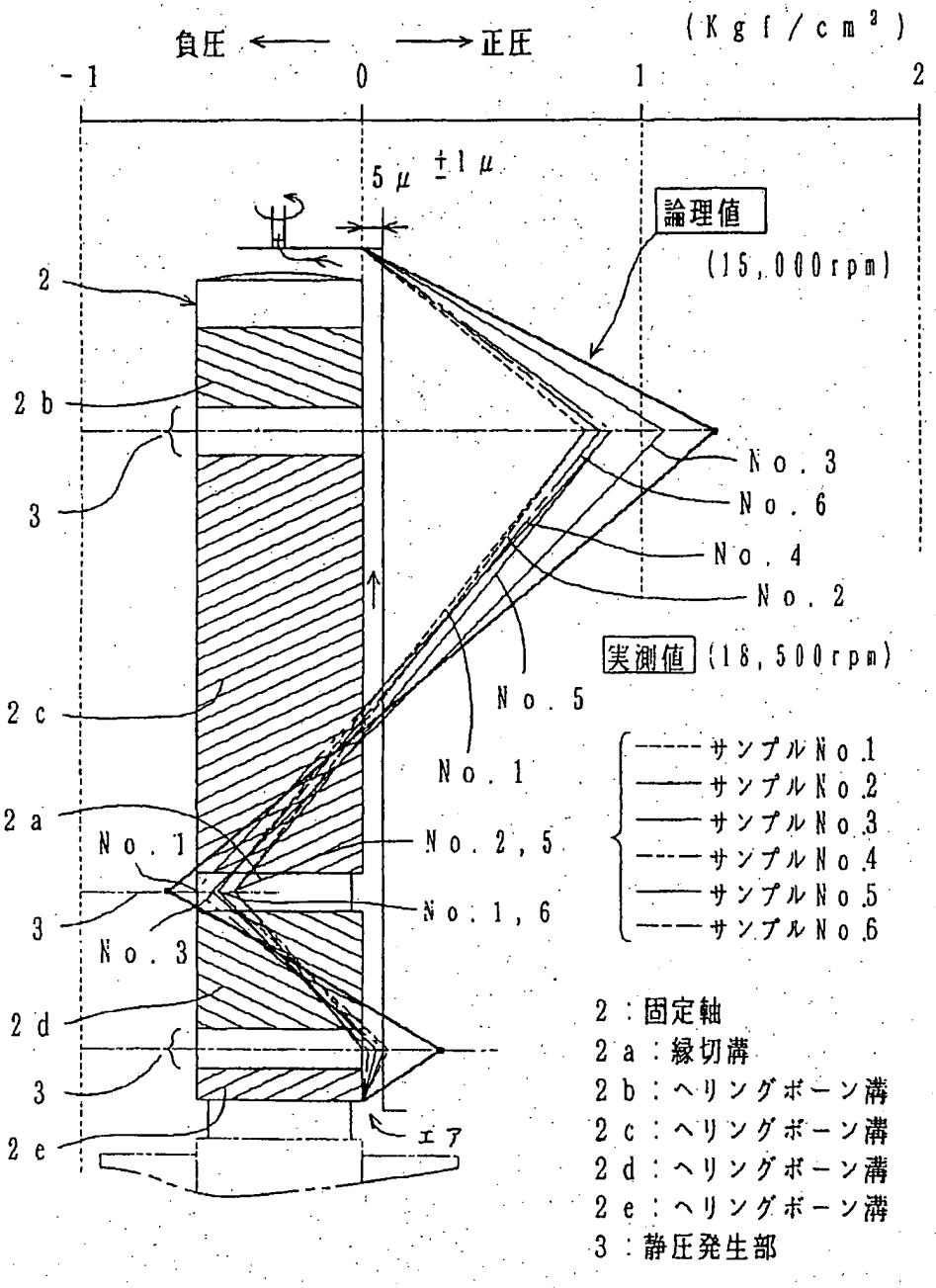
[Drawing 3]

本発明の一実施例に係る動圧気体軸受の断面図



[Drawing 4]

本発明の固定軸の周囲の圧力分布を示す
圧力分布図



[Translation done.]